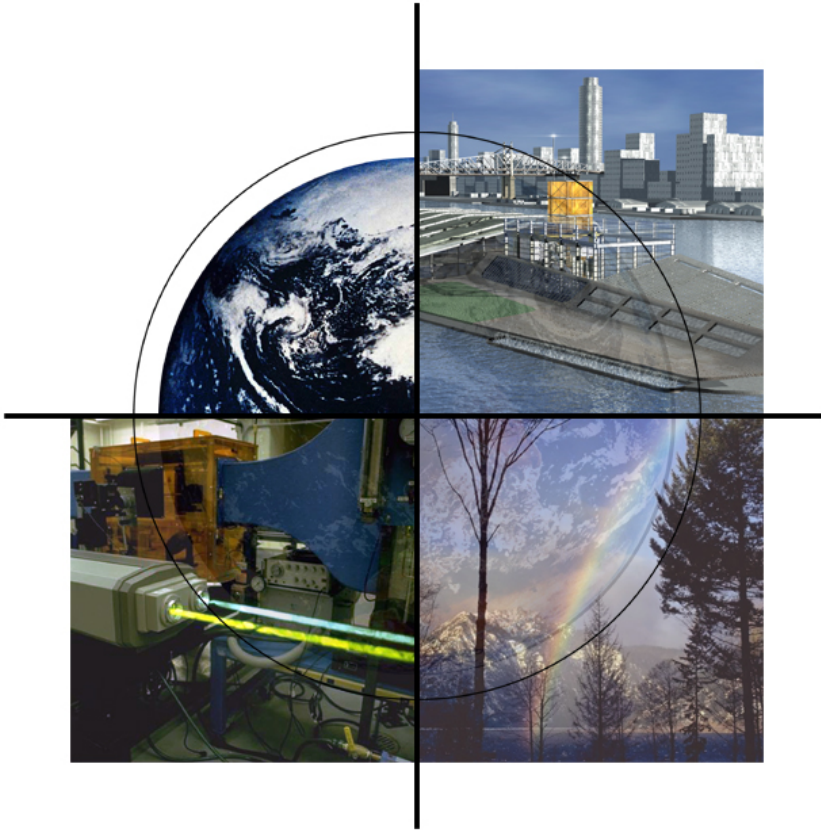


Advanced Research Technologies

**DOE/NSF EPSCOR
Conference 2005**

**Morgantown, WV
June 14-16, 2005**



**Robert Romanosky, Technology Manager
National Energy Technology Laboratory**



Advanced Research - Power Systems

Ingenuity, innovation and implementation

Objectives

- ❖ Bridge the gap between basic and applied research
- ❖ Foster the development of innovative systems
- ❖ Improve efficiency and environmental performance, reduce cost



Advanced materials consortium for ultra-supercritical power plants



*Computational Energy Sciences
Scientific Consortium, visualization,
Modeling, and simulation*

R&D Activities

- **Advanced Materials**
- **Novel Sensors & Controls**
- **Adv Power Plant Simulations**
- **Bioprocessing Technologies**
- **Educational Foundation Programs**

Advanced Research Program

The Programs within the Program

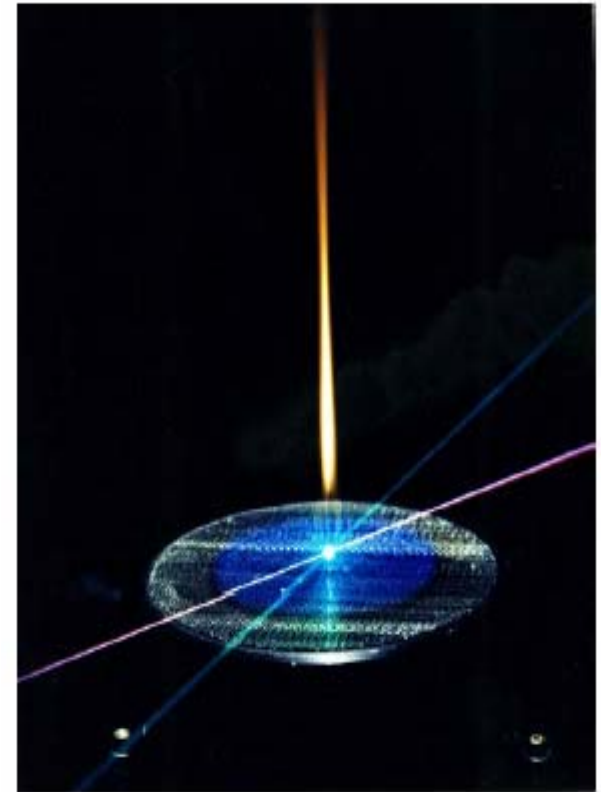
- **Coal Utilization Science (CUS)**
- **Advanced Materials Program and Metallurgical Research**
- **Computational Energy Sciences Focus Area (CES)**
- **University Coal Research (UCR)**
- **Historically Black Colleges and Universities/Other Minority Institutions (HBCU/OMI)**
- **Bioprocessing of Coal**



Coal Utilization Science

The Coal Utilization Science Program develops enabling technologies that are critical to overcoming identified barriers that will make possible the successful deployment of advanced energy plants capable of achieving high efficiencies with extremely low or near-zero emissions. The research is pursued in several major program areas:

- Instrumentation, Sensors, & Control
- Separations Technologies
- Energy Conversion Chemistry
- Visualization, Design, and Integration
- Mechanistic Model Development
- Carbon Capture and Sequestration
- Advanced Concepts and Systems Studies



*Combustion of pulverized coal
in flat-flame burner with laser
diagnostics*

Materials Program and Advanced Metallurgical Research

The goal of the FE Advanced Research Materials Program is to provide a materials technology base to ensure the success of coal fuels and advanced power generation systems being pursued by DOE-FE. In efforts to meet this goal, the Program is engaged in the following activities:

- Exploratory research designed to develop new materials, ideas, and concepts that have the potential to improve the performance or reduce the cost of existing fossil fuel technologies
- Development of the materials of construction including processing and fabrication methods and functional materials necessary for those systems

Research Areas

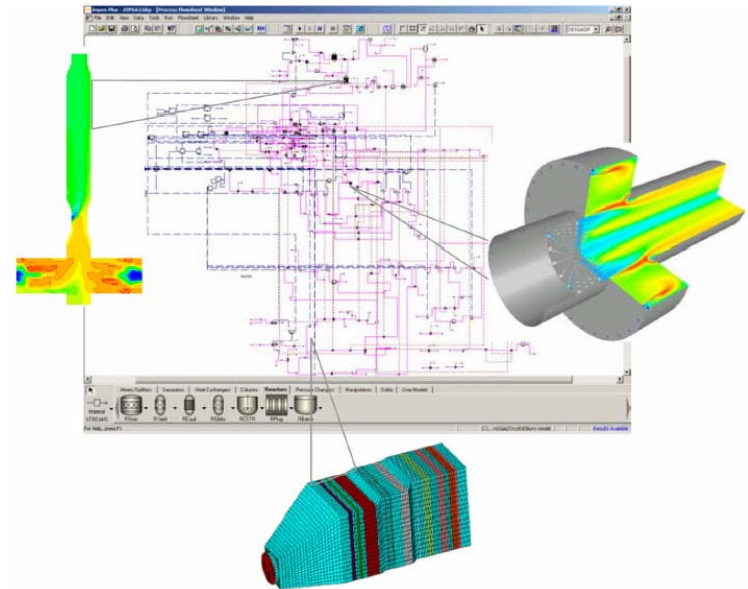
- **New Alloys**
- **Functional Materials**
- **Ultrahigh Performance Materials**
- **Coatings & Protection of Materials**
- **Ultra Supercritical Materials**
- **Gas Separation Systems**



Computational Energy Sciences Focus Area (CES)

The CES Program develops tools for the simulation and modeling of fossil energy systems utilizing SOTA high speed computing resources for

- model validation;
- device-scale modeling techniques;
- better multiphase flow models;
- visualization capabilities; and
- MFIX multiphase code improve the fidelity of the integrated system modeling.



University Coal Research Program

The University Coal Research (UCR) Program has maintained three specific goals since its inception in 1980 (by Congressional direction):

- Sustain a national university program of research in energy and environmental science and engineering related to coal that focuses on innovative and fundamental investigations pertinent to coal conversion and utilization;
- Provide a future supply of coal scientists and engineers through research exposure in coal technologies while advancing the science of clean energy from coal; and
- Improve our fundamental scientific and technical understanding of chemical and physical processes involved in the conversion and utilization of coal, one of our nation's most abundant natural resources and by-products from coal processing.



Historically Black Colleges & Universities/ Other Minority Institutions (HBCU/OMI)

The HBCU/OMI Program emphasizes improving energy/environmental capabilities in advanced coal, oil, gas, and environmental technology concepts, and supports the education of scientists and engineers from diverse backgrounds by sponsoring research in support of NETL's technology lines at schools designated as HBCU/OMI. The Advanced Research Technology Team strives to accomplish the following goals:

- Provide and promote opportunities for HBCU/OMI in science and engineering.
- Foster private sector participation and interaction with HBCU/OMI in fossil energy-related programs.
- Provide a forum to facilitate technology transfer, strengthen educational training, and develop/enhance the research infrastructure capabilities of HBCU/OMI.



Bioprocessing of Coal

The Bioprocessing Program research employs natural biological processes and mechanisms for clean energy generation. This Program funds research with emphasis on the following areas:

- **Biosequestration**—The conversion of atmospheric CO₂ into plant biomass via photosynthesis by algae.
- **Bioremediation**—The removal or reduction of chemical pollutants and species by bacterial activity.
- **Bioprocessing**—Employing bacterial activity for the production of useful chemicals while generating minimal toxic byproducts.